DOCUMENT RESUME

ED 311 874 IR 013 993

AUTHOR Mehan, Hugh
TITLE Microcomputers and Classroom Organization: The More Things Change the More They Change Each Other. Interactive Technology Laboratory Report #10.
INSTITUTION California Univ., San Diego, La Jolla. Center for Human Information Processing.
PUB DATE Dec 85
NOTE 24p.; Paper presented at the Annual Meeting of the American Anthropological Association (Washington, DC, December 1985).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Adoption (Ideas); Computer Assisted Instruction; *Cooperative Learning; *Educational Innovation; Elementary Education; Elementary School Curriculum; *Microcomputers; *Social Environment; Teaching Methods; *Technology Transfer

ABSTRACT

This study examined the effect of microcomputer use on classroom social organization and curriculum. To determine whether teachers who have a microcomputer available for instruction use time and space differently and make modifications in what they teach and how they teach, observations of four elementary school teachers (grades two through six) in San Diego were conducted as they introduced and used microcomputers in their classrooms. The students represented a diverse population in terms of measured ability, socioeconomic status, and ethnicity. Their teachers had varying degrees of computer knowledge. Findings indicate that there was no significant change in the way in which teachers arranged the space and used time in their classrooms as a result of having microcomputers available for instruction on a full time basis. The microcomputers were incorporated into previously established practices for organizing instruction, regardless of the teacher's previous knowledge of computers, demonstrating the resilience of classrooms when attempts are made to introduce change. A different sense of social relations developed. Students assisted each other at the computer and cooperated in the completion of assigned tasks. Microcomputers had an impact on the curriculum by providing a means to meet previously established goals as well as a means through which previously unattainable goals could be reached. (31 references) (GL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED311874

Report #10

Microcomputers and Classroom Organization: The More Things Change the More They Change Each Other

Hugh Mehan

University of California, San Diego

December, 1985

Paper prepared for presentation at the Annual Meetings of the American Anthropological Association, Washington, D.C., December, 1985.

IR013993

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Randall Souviney

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

MICROCOMPUTERS AND CLASSROOM ORGANIZATION:

The More Things Change The More They Change Each Other

Hugh Mehan

The role of the microcomputer in our schools is a matter of intense debate. On the one hand, we are being told that we are in the midst of a computer revolution, (e. g. Papert, 1980) in which the computer is or will be the cause of changes in the way in which we teach and think, the organization of work, social relations, even the meaning of citizenship. On the other hand, skeptics of the computer revolution (e. g., Noble, 1985; Tyack and Hansot, 1985) say that the microcomputer will fall prey to the same forces that relegated previous technological innovations like radio, educational television to storage rooms and closets.

Since microcomputers are such a bone of contention in education, it is important to look closely at the actual functions that microcomputers are performing in classrooms. We are interested to know whether the availability of microcomputers in classrooms has an influence on (a) the social organzation of the classroom and (b) the curriculum. That is, do teachers who have a microcomputer available for instruction use time and space differently and make modifications in what they teach and how they teach?

In order to investigate the relationship between computer availability and classroom organization, we observed four elementary school teachers as

they introduced and used microcomputers in their classrooms. The classrooms, located in the "North County" area of San Diego, had diverse populations in terms of age, measured ability, socioeconomic background and ethnicity (for more details, see Mehan et al, 1985: 21-57). The grade levels ranged from 2nd to 6th grade. The students' abilities were measured from the lowest CTBS quartile to GATE qualification. One classroom was part of a designated bilingual program, two others had a number of students who spoke Spanish as a first language and one was designated a Chapter 1 classroom.

The teachers had varying knowledge about microcomputers. All four of the teachers in this project were expert teachers. But not all four were expert concerning the use of microcomputers. Two of the teachers, BL and KW, had neither previously used a microcomputer on a regular basis, nor had formal training in computer programming or computer use. Two of the teachers, BMS and RR, had extensive experience using microcomputers but had not had them available for full time classroom use prior to this project. BMS had access to an Apple // for her classroom on a part time basis during the previous academic year, voluntarily led after school computer clubs and had taught classes on word processing through a university extension program. RR was in his third year of regular computer use. After using computers for math and language arts instruction in his classroom on a part time basis, he now had the additional responsibility for leading his school's computer lab. This project made a microcomputer available to him to use full time within his classroom.

At the beginning of the school year, that is, before microcomputers were introduced into the classrooms, there were two main systems of organizing

classrooms for instruction. BL and RR used "whole group" arrangements as the primary mode of delivering instruction. BMS and KW used "learning centers" as the primary mode of delivering instruction.

The variation in teachers' knowledge about microcomputers and the manner in which they arranged their classrooms for instruction provided us an opportunity to examine the impact of microcomputers on classroom organization and instruction. The relationships among teachers' previous knowledge about computers and the manner in which they arranged their classrooms at the beginningof the school year are shown below:

Figure 1

	Teachers' Previous Knowledge about Computers	
	Expert	Novice
Classroom Arrangements: Whole Group	RR	BL
Classroom Arrangements: Centers	BMS	KW

I will discuss the relationship between microcomputer use and classroom organization under two headings: (1) the impact on temporal and spatial arrangements and (2) curriculum--what teachers teach and how they teach it. For a more extensive examination of the changes which took place in the bilingual teacher's classroom, see Moll and Newcomb (1985).

We are trading off the convergence of ideas from two quite different theoretical approaches to organize our observations. One of these theoretical

approaches is called the study of "activity structures" and is associated with Bossert (1977) and Doyle (1978). The other is called the study of "participant" or "participation" structures," a notion which was developed by Philips (1972; see also 1982), and has been used by Mehan (1979) to talk about the social structuring of classroom lessons, and by Erickson and Mohatt (1982) Bremme and Erickson (1977), Florio (1978), Au (1980) and Moll and Diaz (in press) to discuss how different kinds of participation structures influence participation in lesson activities.

Both approaches suggest that classroom activities can be depicted along a number of dimensions. These include (1) the size and the organization of the work group, e. g., whether the class is organized into one learning unit ("whole group" instruction) or is broken down into small groups or is organized so that the teacher works with students on a one-to-one basis; (2) the task organization in the classroom (e. g., whether the whole class is working on a single task or small groups are working on many tasks simultaneously); (3) the response opportunities available to students in a recitation (e. g., whether students respond individually or in a chorus); (4) the response obligations (e. g., whether students are allowed to respond voluntarily or responses are obligatory); and (5) evaluation (e. g., whether evaluation of work is conducted in private or in public).

These dimensions of classroom life orient our description of the relationship between microcomputer use and classroom organization as well as our comparision of the structure of instruction when computers are used and instruction when computers are not used.

Impact on Spatial and Temporal Arrangements

There was no significant change in the way in which the teachers, BL, BMS, RR and KW arranged the space and used time in their classrooms as a result of having a microcomputer available for instruction on a full time basis. Both BMS and KW had used learning centers extensively in previous years; both teachers used this spatial and instructional configuration when a microcomputer was made available to them by this project. BL and RR had used whole group methods of instruction in previous years; they continued to teach their classses in this manner when this project made a microcomputer available for their use.

Microcomputer and Existing Classroom Arrangements

BMS and KW injected the microcomputer into their on-going learning center arrangements. KW established a "Computer Learning Center" to complement her Art Center, Science Center, Map Center and her Listening Center. Students rotated between these centers, a teacher-led reading group and individualized seat work during the course of a morning's language arts work. In a similar manner, BMS used the microcomputer to complement her previously established methods of instructing reading and writing. BMS taught Language Arts to small groups within the framework of three activity centers (called "stations"). Three language arts ability groups rotated through the three centers four days a week. One station was devoted to reading comprehension activities, another was dedicated to reading in content areas such as Science or Social Studies, and the third to a variety of individualized activities. The computer was made a part of the third station and was used to enhance a number of activities taught in other parts of the

Language Arts framework.

The structure of participation in both BMS's and KW's classroom varied with the activity being conducted. "Group work," in which students carried out teacher organized activities without direct adult supervision, was characterized by voluntary, student initiated participation. "Reading Group," in which students read and discussed texts, was more teacher directed. In a typical reading group, students were first asked questions about their experiences with a topic that had been read or would be read in the next assignment. The students were encouraged to offer personal opinions, interpretations and provide answers that diverge from previous answers. The teacher insisted that one student speak at a time, but access to the floor was voluntary. The floor was obtained by bidding or by nominations from the teacher. After a round or two of general discussion, the teacher oriented the students to the work they had been reading. The discussion turned to a link between personal experiences and the events and activities being discussed in the book being read. Very little actual reading took place at the reading circle. Reading was assigned as seat work and for homework. When reading was done in the reading group, it was often to validate a point of interpretation being made about the text. "Writing" and "seatwork" were both done at the student's personal desk. The general pattern for the writing activity involved students generating text based on topics provided by the teacher. Seatwork was a time for students to complete assignments, read books from the reading group or do homework. During these times, students worked without supervision, at their own pace.

RR taught his class as a whole group followed by discussions and then

seat work with students working alone or in small groups. The typical pattern of instruction was for RR to present material to the whole class and then engage students in a discussion. Students worked on the lesson activities after the large group presentation. During these work periods, the teacher and his aide assisted students by answering questions privately and by giving encouragement. RR placed the microcomputer against one of the classroom walls. Pairs of students were scheduled at the computer in 25 minute intervals throughout the morning. As each pair's turn came, they left the work they were doing and went to the computer.

BL responded to the availability of a microcomputer for classroom instruction in much the way that RR did. She arranged the students' desks into rows and primarily instructed her students as a group while they were seated at their desks. She established a computer center against one of the classroom walls. At first situated by the door, she moved it to a location closer to her desk after 6 or 7 weeks of use so that she could monitor students' activities at the computer more effectively. The computer was partially hidden and isolated from the rest of the classroom by a divider, which also served as a display board for the computer users, containing disks, instructions and other relevent information. From her usual position at the front of the class, BL had a clear view of the children working at the computer and in other parts of the room. The children were assigned in pairs to use the machine for 30 minute intervals. Each Monday morning BL described the computer activity for the week, her expectations for their work and provided examples of the procedures they were to follow.

The manner in which the teachers set up the computer center in their classrooms had consequences for students' learning. The teachers who used

learning centers rotated all students through the computer center which meant that they were not removed from other classroom activities. The teachers who used "whole group" instruction, however, removed students from other activities to work at the computer center. As a consequence, they had to have students make up for the course work they missed while they were at the computer center. RR's solution to the problem was to make it clear to the students that it was their responsibility to make up for the work they missed while working at the computer. BL used an elaborate schedule to provide students with opportunities to make up for missed work.

A New Dimension of Participation: Dyadic Peer Interaction

While the introduction of a microcomputer for the purposes of instruction did not modify existing spatial and temporal arrangements in the four project classrooms, the availability of a microcomputer added a new dimension of participation to the classrooms. Each of the teachers in this project decided to have two students work at the computer at one time. The teachers made these decisions for pragmatic and pedagogic reasons. Two students working at a computer increases, perhaps doubles, the total access time that a student has to the computer. Since each of the teachers in this project had 30 or more students and one computer, the logistics of organizing instruction limited the number and length of work sessions. By placing two students at the computer at one time, our teachers found that they could provide students with two 25-30 minute sessions a week, one devoted to math and one devoted to language arts.

Dyadic peer interaction was the new structure of participation that emerged when two students were placed together to work at the computer. Students were given assignments for work sessions at the computer by the teacher, either verbally at a whole-group orienting session, or in writing at the computer center itself. Students worked together at the computer center. The teachers posted numerous sets of instructions around the computer. The first set gave students instructions with basic "boot up" activities. Supplementary instructions were added to give more specific instructions about each week's activities. Students worked together on the assigned activity carrying out the teacher's assignments without direct adult supervision. When they had difficulty with computer operations, they often called to the teacher for help. However, the teachers' typical response was to encourage the students to use each other as resources, consult the written instructions around the computer, or to go to other students for assistance.

The teachers did not dictate a particular form of interaction to the student pairs. They were left to their own devices to sort out the manner in which the task would be completed. In that sense, the students' participation in the computer activity was voluntary, not compulsary. While they were responsible for completing their assigned session at the computer, the details of how that session would be completed was left to the students. Since the teacher did not monitor the students at the computer directly, their work was not evaluated moment-to-moment or publically, as it so often is in regular classroom lessons (Mehan, 1979). Although the teachers did not monitor the students' work at the computer directly, incidental teacher evaluation was almost always present. As part of their regular travels around the classroom, teachers passed by the computer center. They often

stopped and checked on students' work, offerred suggestions, or were called upon by the students for help.

Students working at the computer also called upon other students for help. These students gave instructions, and in the process, commented on students' work. The verbal interaction that occurred at these times was an important mechanism of understanding. In trying to explain material to others, the students seem to have been led to restructure their own understanding. The verbal interaction was also important because it led students to hear different points of view, which in turn led to cognitive conflicts. Cognitive conflicts are important, it has been suggested, (Piaget, 1971; Miyake, 1985), because it forces learners to examine their own understandings and to seek resolutions in conflicting viewpoints.

As a consequence of the addition of this participation structure, students developed a different, more cooperative, sense of social relations. The cooperative interaction we observed in naturally occurring dyadic peer interaction at computer centers is very similar to that reported by researchers who have arranged "cooperative learning sessions" (Webb, 1982; Slavin, 1980; Kagan, 1985). The students assisted each other at the computer in ways that were different from their experiences in other parts of the school day. They often corrected each other's mistakes, modelled possible answers to problems, and demonstrated ways to complete assigned tasks.

Another consequence of dyadic peer interaction was that it provided social resources which facilitated learning. In language arts activities, even when neither student began an assignment with an idea of what to do, the

discussion of the problem often presented the students with the way to proceed. In the process of entering text, the student who was typing was often concerned with such local issues as the spelling of a word, while the other student concentrated on more global issues such as the construction of the essay and coherence among sentences.

Impact on Curriculum

BMS, RR and KW entered the project approaching Language Arts instruction from a perspective that integrates the teaching of reading with the teaching of writing. BL developed expertise in this approach during the school year. By emphasizing the writing process (Cooper and Odell, 1978), these teachers used the texts that students read to create opportunities for students to write. In turn, texts that students wrote became a basis for later reading.

The computers were thoroughly incorporated into the instructional plan of the language arts curriculum. The teachers planned for computer activities in the same manner that they planned for other instructional activities. The computer was used in all phases of the writing process--pre-writing, writing, response, revision, evaluation and post writing. The computer was not an isolated piece of educational technology that students were taught about. It was a functioning part of the classroom environment and was used as frequently and in the same way as tables, chairs, typewriters, tape recorders, paper, pencils, chalk and chalkboard.

A New Means to Meet Established Curricular Goals

The teachers organized tasks for the microcomputer that were coordinated

with tasks that were carried out in other parts of the curriculum. Reading and writing activities that were taught using paper, pencils and chalkboards were coordinated with activities that were taught using the microcomputer. For example, a poetry writing activity begun with paper and pencil was extended to the computer center where a similar writing activity took place. In this role in the language arts curriculum, the microcomputer was a means to meet previously established educational goals.

Students use of word processing systems facilitated the development of the students' control over the reading and writing processes. This improvement seems to have occurred, in part, because the screen editing and printing capabilities of microcomputer systems improved the production of students' texts by subordinating the mechanical details of writing (such as producing neat script, spelling and correcting errors) to the higher order goals of clear writing, fluency and the flow of ideas.

This statement should not be interpreted as a claim that word processors are responsible for improved writing, however. The computer by itself is not an agent of change. In and of themselves, word processing systems can not teach children to read and write. While we have found that word processing systems can not transform unskilled writers into skilled ones, they do have properties that enable teachers to make a new social organization for reading and writing possible. It is this social organization and not the microcomputer that changed both what was taught and the way in which it was taught in the project classrooms.

Language arts instruction was organized with a microcomputer to

Having an audience with which students were unable to communicate verbally, but with which they wanted to share ideas, gave students a purpose for writing. This writing for a purpose and not "just writing" or even writing on the computer, subordinated students' concern for the mechanics of writing to the goal of communicating clearly (Riel, 1985).

When the students realized that other people would read their work for the information they provided and not just to evaluate its form, they took more control of their writing. They engaged actively in revising and editing their own writing and the texts of their peers. After students wrote and edited their articles for the Newswire, the articles were submitted to a local editorial board for consideration. If the local editorial board, composed of five to eight students, accepted an article, then it appeared in the classroom newspaper and was read by the author's family and friends. Articles were also sent over the newswire to other schools, where other students reviewed their work and decided whether to include it in their local newspapers. If accepted in these remote locations, then not only local peers, but people in Alaska, Hawaii and Mexico read their work. This goal of writing for an audience was extremely effective in motivating both reading and writing (Riel, 1985b).

The creation of functional learning environments for reading and writing by integrating the microcomputer into the language arts curriculum also seemed to have some influence on the quality and frequency of the students' writing. This change was most pronounced in BMS' classroom; her students gained over the course of the school year three grade levels in language mechanics and two grade levels in language expression on the CTBS, a

nationally normed language arts test. These findings are particularly noteworthy because gains in writing do not often show up on standardized tests. Similar though less pronounced gains were recorded in the other classrooms. The second greatest gains were recorded in KW's classroom. Students in BL's classroom and in a control classroom showed the least gains in writing quality and frequency.

This order leads Riel (1985) to conclude that a combination of factors, not the mere presence of the microcomputer is important for the changes that occurred. These factors are: computer knowledge, experience in teaching writing as a process and integrating the microcomputer into the language arts curriculum. When all three of these factors were present in one classroom, the students showed the greatest improvement in writing skills. When one or more of these factors were absent, the students showed some but not as significant improvement.

The greatest gains were recorded in BMs' classroom; BMS is a teacher who had previous experience using the microcomputer in her classroom, had experience teaching writing as a process, and integrated the microcomputer into her language arts curriculum. KW had experience teaching writing as a process and integrated the computer into the language arts curriculum, but she did not have previous experience using the microcomputer. BL, you will recall, had neither previous computer experience nor previous experience teaching writing as a process. Like BMS and KW, she did integrate the microcomputer into her language arts curriculum. KOL, the control teacher, taught writing as a process, but did not have access to the computer; her students showed gains that were similar to those of BL's students.

Summary and Conclusions

In this paper, I have considered whether the availability of a microcomputer for day-to-day instruction in classrooms affects the way in which teachers arrange their classrooms or modifies what teachers teach and how they teach.

While there is no doubt that there are widespread changes associated with the microcomputer in the world of work and education, our research in the classroom suggests that it would be inappropriate to conclude that the computer, in and of itself, is a causal agent of change. When used in educational settings, the microcomputer is always a part of a larger social system, which includes the students, the teacher, their history of past relationships, the history of ways of teaching, the history of ways of organizing classrooms, the relationship that the classroom curriculum has to to the classroom surroundings, and the relationship between the classroom and the school, community and agencies beyond.

There was no significant change in the way in which the teachers arranged the space and used time in their classrooms as a result of having microcomputers available for instruction on a full time basis. The microcomputer was incorporated into previously established practices for organizing instruction. Teachers who used learning centers previously did so again when microcomputers became available. Teachers who typically taught their classrooms as a whole followed by discussions and individual seat work continued to do so when they had microcomputers. This pattern was the same regardless of the teachers' previous knowledge about computers.

The absence of changes in temporal and spatial arrangements that we observed when microcomputers were introduced into classrooms shows how resilient that classrooms are to attempts to change (Sarason, 1982; Cuban, 1983). If the results of our modest investigation are replicated in other school settings, then we would not be surprised if microcomputers continue to be inserted into existing classroom arrangements (Michaels, 1984) and do not lead to wholesale changes in classroom organization.

While the introduction of a microcomputer did not modify existing spatial and temporal arrangements, the availability of a microcomputer added a new participation structure to the classroom. Teachers placed two students together at the computer. Peer interaction emereged from this arrangement. Students worked together at the computer without direct adult supervision. They were left to their own devices to sort out the manner in which tasks would be completed. While students were responsible for completing their assigned work at the computer, the students worked out the details of task completion themselves, resulting in voluntary instead of compulsary forms of instructional activity. Since the teachers did not monitor the students' work at the computer directly, their work was evaluated privately instead of publically by the teacher. As a consequence of this change in participation structures, students developed a different sense of social relations. They assisted each other at the computer and cooperated in the completion of assigned tasks.

Microcomputers also had an impact on the curriculum in these classrooms. They served as a means to meet previously established educational goals, and they provided a means through which previously

unattainable goals could be reached. The teachers used the microcomputers to create functional learning environments in which reading and writing was arranged for communicative purposes. The "Computer Chronicles Newswire" gave students a reason for writing: to share ideas and concerns with other students with whom direct interaction is not possible. The public nature of writing provided motivation for re-writing and editing, giving students increased knowledge of educational technology.

The teachers' connection to the student newswire service enabled them to achieve important educational goals, goals that they could not have achieved as readily had a microcomputer not been available for their use. Students from different countries were able to interact via microcomputers and telephone lines and participate in joint problem solving activities centered on instructional issues. As a component in a unique electronic communication system, the microcomputer has the potential to help teachers address important curricular objectives. While students are developing their skill in using the computer for word processing, they are being placed in contact with students from different cultural backgrounds. In the context of gaining experience in communicating across cultural and linguistic boundaries, teachers and students are provided with the opportunity to gain understanding of the norms and traditions of different cultures and to thereby increase understandings of their own cultural norms and traditions.

In short, the microcomputer was accommodated into existing classroom organizational arrangements, but was associated with changes in teacher-student relations and curriculum. As a result of our year long investigation of microcmputer uses in four very different classrooms, we are led to dismiss two of the more extreme predictions about the role of microcomputers in

education: those which predict a complete transformation of education (e.g., Papert) and those which predict the continuation of the status quo e.g., Tyack).

Predictions which say that the availability of microcomputers will cause wholesale changes in education have not been sensitive to the nuances of the social organization of the school, the persistence of ritual and tradition and the extent to which a change in one aspect of the social system affects all other aspects of the system. Predictions which say that classroom culture will dictate the organization of classroom computer use may be premature, because educators have only begun to explore the new curricular possibilities that microcmputers provide (e.g., providing a functional audience for writing via telecommunications, science and math simulations). At this point in our investigations, therefore, we are inclined to dismiss the two prevailing views about computers in schools as too extreme, and instead adopt a perspective that characterizes the relationship between classroom organization and computer use as a mutually influential one.

References

Au, K.H. On participation structures in reading lessons. Anthropology and Education Quarterly XI, 1980, 2: 91-115.

Bossert, S.T. Tasks, group management, and teacher control behavior: a study

of classroom organization and teacher style. School Review, 1977: 552-565.

Bremme, D. & Erickson, F. Relationships among verbal and nonverbal classroom behavior. Theory into Practice, 1977, 5(3): 153-161.

Cooper, C. & L. Odell (eds.) Research on Composing: Points of Departure. Urbana, Ill.: National Council of Teachers of English, 1978.

Cuban, L. How Teachers Taught. New York: Longmans, 1983.

Doyle, W. Classroom Tasks and Student Abilities. Conceptions of Teaching. P.L. Peterson & H.J. Walberg (eds.). Berkeley: McCutchen, 1978.

Erickson, F. & Mohatt, G. Participant Structures in Two Communities. pp. 132-174. Doing the Ethnography of Schooling. G.D. Spindler (ed.), New York: Holt, Rinehart and Winston, 1982.

Florio, S. Learning How to Go to School. Cambridge, Mass.: Unpublished PhD Dissertation, Harvard University, 1978.

Kagan, S. Cooperative Learning and Sociocultural Factors in Schooling. Sociocultural Factors in Bilingual Education. Sacramento, CA: Bilingual Education Office, to appear 1985.

Laboratory of Comparative Human Cognition. Model system for the study of learning disabilities. Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 1982, 4(3): 42-65.

Levin, J.A. et al. Muktuk Meets Jacuzzi: Computer Networks and Elementary School Writers. S.W. Freedman (ed.), The Acquisition of Written Language: Revision and Response. Hillsdale, N.J.: Ablex, 1984.

Levin, J.A. Microcomputers as interactive communicative media: an interactive text interpreter. Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 1982, 4: 34-36.

Mehan, H. et al. Computers in Classrooms: A Quasi-Experiment in Guided Change. Final Report to the National Institute of Education. La Jolla, Ca.: Interactive Technology Laboratory, 1985.

Mehan, H. Learning Lessons. Cambridge, Mass.: Harvard University Press, 1979.

Michaels, S. The impact of the culture of learning on microcomputers. Paper presented at the American Anthropology Meetings, Denver, November, 1984.

Miyake, N, Constructive interaction and the iterative process of understanding. Cognitive Science, to appear.

Moll, L. & S. Diaz. Bilingual communication and reading: the importance of Spanish in learning to read in English. Elementary School Journal, in press.

Moll, L. & A.M. Newcomb. Computer Activities in a Bilingual Setting. Computers in Classrooms. H. Mehan et al. Final Report to NIE. La Jolla, Ca.: UCSD, Interactive Technology Laboratory, 1985.

Newman, D. Functional Learning Environments. Technical Report #25. Center for Children and Technology. New York: Bank Street College of Education, 1984.

Noble, D. The underside of computer literacy. Raritan, 1985, 41-64.

Papert, S. Mindstorms. Cambridge, Mass.: MIT Press, 1980.

Philips, S. Participant Structures and Communicative Competence. pp. 370-394. Functions of Language in the Classroom. C. Cazden et al (eds.), New York: Teachers College Press, 1972.

Philips, S. The Invisible Culture: Communication in Classroom and Community on the Warm Springs Indian Reservation. New York: Longmans, 1982.

Piaget, J. Main Trends in Psychology. New York: Harper & Row, 1970.

Riel, M.M. Investigating the system of development: the skills and abilities of dysphasic children. Center for Human Information Processing, Report 115, La Jolla, Ca.: University of California, San Diego, 1983.

Riel, M.M. The Computer Chronicles Newsire: A functional learning

environment for acquiring literacy skills. Journal of Educational Computing Research, 1985, 1(3): 317-337.

Riel, M.M. A functional Learning Environment for Writing. H. Mehan et al, Computers in Classrooms, Final Report to NIE, La Jolla, Ca.: Interactive Technology Laboratory, 1985.

Sarason, S. The Culture of the School and the Problem of Change. Boston: Allyn & Bacon, 1982.

Slavin, R. Cooperative learning. Review of Educational Research, 1980, 50: 315-342.

Tyack, D. & E. Hansot. Futures that Never Happened: Technology and the classroom. Commentary. Education Week, September 4, 1985.

Webb, N. Student interaction and learning. Review of Educational Research, 1982, 52: 421-445.